ADDITIVES IN GYPSUM PANELS AND ADJUSTING THEIR PROPORTIONS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of U.S. Ser. No. 61/239,259 filed Sep. 2, 2009 and entitled, "Additives in Gypsum Panels and Adjusting Their Proportions," herein incorporated by reference. This application is related to co-pending U.S. Ser. No. 12/552,338, filed Sep. 2, 2009 and entitled "Formulation and Its Use," herein incorporated by reference.

BACKGROUND OF THE INVENTION

This invention relates to gypsum products. More specifically, it relates to a gypsum-based panel that requires less time or less energy for drying than conventional products.

Gypsum-based panels are commonly used in construction. Wallboard made of gypsum is fire retardant and can be used in the construction of walls of almost any shape. It is used primarily as an interior wall or exterior wall or ceiling product. Gypsum has sound-deadening properties. It is relatively easily patched or replaced if it becomes damaged. There are a variety of decorative finishes that can be applied to the wallboard, including paint and wallpaper. Even with all of these advantages, it is still a relatively inexpensive building material.

One reason for the low cost of wallboard panels is that they are manufactured by a process that is fast and efficient. Calcium sulfate hemihydrate hydrates in the presence of water to form a matrix of interlocking calcium sulfate dihydrate crystals, causing it to set and to become firm. A slurry that includes the calcium sulfate hemihydrate and water is prepared in a mixer. When a homogeneous mixture is obtained, the slurry is continuously deposited on a moving surface that optionally includes a facing material. A second facing material is optionally applied thereover before the slurry is smoothed to a constant thickness and shaped into a continuous ribbon. The continuous ribbon thus formed is conveyed on a belt until the calcined gypsum is set, and the ribbon is thereafter cut to form panels of desired length, which panels are conveyed through a drying kiln to remove excess moisture. Since each of these steps takes only minutes, small changes in any of the process steps can lead to gross inefficiencies in the manufacturing process.

The amount of water added to form the slurry is in excess of that needed to complete the hydration reaction. Excess water gives the slurry sufficient fluidity to flow out of the mixer and onto the facing material to be shaped to an appropriate width and thickness. As the product starts to set, the water pools in the interstices between dihydrate crystals. The hydration reaction continues building the crystal matrix in and around the pools of water, using some of the pooled water to continue the reaction. When the hydration reactions are complete, the unused water occupying the pools leaves the matrix by evaporation. Interstitial voids are left in the gypsum matrix when all water has evaporated. The interstitial voids are larger and more numerous where large amounts of excess water are used.

While the product is wet, it is very heavy to move and relatively fragile. The excess water is removed from the board by evaporation. If the excess water were allowed to evaporate at room temperature, it would take a great deal of space to stack and store wallboard while it was allowed to air dry over a relatively lengthy time period or to have a conveyor long

enough to provide adequate drying time. Until the board is set and relatively dry, it is somewhat fragile, so it must be protected from being crushed or damaged.

To hasten evaporation, the wallboard panel is usually dried by evaporating the excess water at elevated temperatures, for example, in an oven or kiln. It is relatively expensive to operate the kiln at elevated temperatures, particularly when the cost of fossil fuels rises. A reduction in production costs could be realized by reducing the amount of excess water present in set gypsum boards that is later removed by evaporation.

Dispersants are known for use with gypsum that help fluidize the mixture of water and calcium sulfate hemihydrate so that less water is needed to make a flowable slurry.

β-Naphthalene sulfonate formaldehyde ("BNS") and melamine sulfonate formaldehyde ("MFS") condensate dispersants are well known, but have limited efficacy. The preparation and use of BNS is well known state of the art and disclosed in EP 0 214 412 A1 and DE-PS 2 007 603, herein incorporated by reference. The effect and properties of BNS can be modified by changing the molar ratio between formaldehyde and the naphthalene component that usually is from about 0.7 up to about 3.5. The ratio between formaldehyde and the sulfonated naphthalene component preferably is from about 0.8 to 3.5 to about 1. BNS condensates are added to the hydraulic binder containing composition in amounts from about 0.01 up to about 6.0 wt. %.

Melamine-sulfonate-formaldehyde-condensates are broadly used as flow improving agents in the processing of hydraulic binder containing compositions such as dry mortar mixtures, pourable mortars and other cement bonded construction materials and in the production of gypsum panels. Melamine is used in this connection as representative of s-triazine. They cause a strong liquefying effect of the construction chemicals mixture while minimizing undesired side effects occurring in the processing or in the functional properties of the hardened building material. As it is for the BNS technology, there is also broad prior art for MFS. MFS dispersants are revealed in DE 196 09 614 A1, DE 44 11 797 A1, EP 0 059 353 A1 and DE 195 38 821 A1.

DE 196 09 614 A1 discloses a water soluble polycondensation product based on an amino-s-triazine and its use as plasticizer in aqueous binder containing suspensions based on cement, lime and gypsum. These polycondensates are capable in two condensation steps whereby in a pre-condensation step the amino-s-triazine, the formaldehyde component and the sulfite are condensed at a molar ratio of 1 to 0.5:5.0 to 0.1:1.5. Melamine is a preferred representative of amino-s-triazines. Further suitable representatives are amino plast former selected from the group urea, thiourea, dicyandiamide or guanidine and guanidine salts.

According to DE 44 11 797 A1 sulfanilic acid-containing condensation products based on amino-s-triazines that show at least two amino groups are prepared by using formaldehyde. The sulfanilic acid is used in amounts of from 1.0 to 1.6 mol per mol amino-s-triazine and neutralized in aqueous solution with an alkaline metal hydroxide or in earth alkaline metal hydroxide. In an additional step the formaldehyde is added in amounts of from 3.0 to 4.0 mol per mol amino-s-triazine at a pH value between 5.0 to 7.0 and at temperatures between 50 and 90° C. The final viscosity of the solution is between 10 and 60 cSt at 80° C.

According to EP 0 059 353 A1 highly concentrated and low viscosity aqueous solutions of melamine/aldehyde resins are capable by reacting melamine and an aldehyde in an alkaline medium in a first step with a component selected from the group comprising alkali sulphate, earth alkali sulphate or